CURRENT SCIENCE

Vol. VI] October 1937 [No. 4

	Page
On the Previous History of the First Law of Thermodynamics. Arnold Berliner	145
Lord Rutherford	147
Rates of Growth of Non-Vegetarian and Vegetarian Children of Trivandrum. By E. W. Erlanson Macfarlane	148
Letters to the Editor	152
Reviews	160
Supplement—The Chemical Effects of Electrical Discharge. By K. R. Dixit	163
The Indian Glass Industry. By E. Dixon	181
Agricultural Research Institute, Coimbatore.	188
Astronomical Notes. T. P. B.	192
Centenaries. By S. R. Ranganathan	193
Research Items	194
Agricultural Research in India	195
Biochemical and Allied Research in India	198
Recent Developments in Indian Geology	199
Science Notes	200
Academies and Societies	204
Erratum	204

On the Previous History of the First Law of Thermodynamics.

A critical history of Physics has appeared only sparingly in physical literature since a creative physicist requires a special incentive to devote his work to the history of physics—and even then only to the history of that part of physics in which he has been working—instead of to physics itself. Anyone other than a creative physicist, rich in ideas, cannot be thought of here as an author; he may do useful work either in the field of bibliography or biography, but he can never value the ideas critically nor can he add anything to a knowledge of their inner relationship. Therefore, works like Planck's "Principle of the Conservation of Energy" (1887), Mach's "Principles of the Theory of Heat" (1896), Dühring's "Critical History of Mechanics" (1873) have their special place in physical literature—not only for the sake of the authors, but also because they have here written history, on which should be focussed the attention of historians as much as that of physicists. On account of this rarity every new contribution made by persons of standing is very valuable for the history of physics—even more so when it belongs to a region whose history appeared to have been completely investigated. The "Thermodynamics"* by Paul S. Epstein, the well-known theoretical physicist of the California Institute of Technology at Pasadena—published this year, contains a section on the history of the First Law, by which everyone interested therein, will find himself enriched.

After the work of Rumford and of Davy during the transition from the 18th century to the 19th, almost forty years elapsed before a well-planned investigation of the mechanical nature of heat began. Besides an engineer (Séguin) there were two physicians who took up the question—Helmholtz was then a physician just as Julius Robert Mayer was. The engineer naturally took up the transformation of Heat into work and *vice versa*, but how did the interest of the physicians arise? Epstein has taken up this question and has referred to hitherto unknown historical relationships. The origin of animal heat was the greatest problem for physicians and physiologists. Since warm-blooded animals continuously give out heat to their colder surroundings their bodies can maintain their almost constant temperature only when as much heat is generated in them every moment as they give out to the surroundings. The question, therefore, turned on the cause of the constancy of temperature of warm-blooded animals. In one of his papers (1843) Joule writes: "Dr. John Davies told me that he had endeavoured from a few years past to explain that part of animal heat, which Crawford's theory had left unexplained, as due to the friction of blood against the veins and the arteries, but that he found a similar hypothesis in Haller's "Physiology" and that therefore he had not

* *Text-Book of Thermodynamics*, by Paul S. Epstein. (John Wiley & Sons, New York), 1937. Pp. xii+406.

followed the question further " (the English physician Crawford had set up the Combustion Theory of Respiration independently of Priestley). This means that Julius Robert Mayer and Helmholtz had an eminent forerunner : Albrecht von Haller who was for fifteen years (1738–53) the pride of the University of Göttingen, the founder of the Göttingischen Gelehrten Gesellschaft, and who was an anatomist, physiologist, botanist and physician. His *Elementa physiologiæ corporis humani* (1757–66) appeared very soon in French and in English and undoubtedly it has influenced several generations of physicians ; in 1822 appeared another German edition, and in 1843 it quoted Dr. John Davies as an authority, as Joule writes. Haller there analyses the activity of the lungs and comes to the conclusion that animal heat is produced here and is communicated to the blood flowing through them. According to his hypothesis it is generated " by an alternate expansion and contraction, by the springing back and the compression of the lung cavity whereby the hard parts of the blood are closely pressed together during the attrition produced by the expiration and continuously rubbed against each other, just as during inspiration they move fast and are powdered. " And it is no objection against this that water cannot be heated by friction ; this conclusion is in fact incorrect since through violent motion water as well as milk can take up a certain amount of heat. Haller's theory of respiration therefore depends essentially upon the idea that heat can be generated by mechanical work and that at every moment, so long as the force (the life force) works—a knowledge fifteen years previous to Rumford's epoch-making experiments ! The physicians and physiologists stuck to this idea in spite of Priestley's Combustion Theory of Respiration and in spite of the support given to it by the measurements of Lavoisier and Laplace (about 1781), they saw in Rumford's and Davy's work only a support for Haller's theory. Lavoisier and Laplace had found that the combustion of carbohydrates in the blood was not sufficient to explain the amount of heat developed, and had expected that the combustion of hydrogen to water would account for the remaining portion. But the announcement of a prize by the Académie des Sciences in the year 1821 first led to the taking up of the necessary investigation. The results communicated by Despretz to the Academy in 1823 (published in 1824) still left about 20 per cent. unexplained and for this he went back to Haller's theory. The work of Dulong published posthumously in 1843, first brought the final stage and put a seal upon the correctness of the Combustion Theory of Respiration. Dulong had already laid his results, which agreed with those of Despretz, before the Academy in 1822, but had not published the same because he doubted the correctness of the thermochemical data regarding the formation of carbonic acid and of water. The figures for the heat of formation of carbonic acid finally proved to be correct but the corresponding values for water were found to be much too small. It was only the improvement made possible by this that removed the error and so provided a proof for the correctness of the Combustion Theory of Respiration. But the physiologists and the physicians were for the last twenty years convinced of its sufficiency. On searching through the literature of that day Epstein came across a *Handbuch der Physiologie* in six volumes, edited by Karl Friedrich Burdach (1776–1847), Professor of Anatomy and Physiology in Königsberg. The last volume of the Handbook of date 1840 contains a history of both theories by Burdach. He first mentions Haller's theory and then the " investigation of the similarity between respiration and combustion ". He shows that between 1820 and 1840 the physicians interested in the theory of respiration were carried away by the part which could not be explained by the combustion theory. Most of them sided Haller and explained the discrepancy by the friction of blood in the arteries. This idea was shared not only by the leaders of science but also by the wider circle of practical physicians, and for this, Epstein refers to two papers of dates 1830 and 1839, as examples. Above all we have here only variations of Haller's theory. Burdach himself does not sympathise with these explanations ; he does not doubt that heat can be generated by work but treats it as generally known, citing Rumford and Davy for the same ; but he only doubts whether all this is quantitatively correct.

According to Epstein's studies, medicine

played a much more important part in the history of the principle of the conservation of energy than has been generally assumed till to-day. It begins in the middle of the 18th century and continues uninterrupted till the middle of the 19th. The physiologists were for half a century the keepers of the idea of the identity of heat and work. Julius Robert Mayer and Helmholtz transplanted it into physics to which it naturally belongs. There lay a further interval between the approximate knowledge of the physicians about the generation of heat by work and the formulation of their equivalence. Julius Robert Mayer lost the credit of the discovery because he could not give any strict proof for the correctness of his ideas, and that in an age which through the failure of Schelling's Natural Philosophy was set quite against all speculations without clinching proofs. Helmholtz was of greater consequence, but Joule's work had, in the meanwhile, built for the principle of the conservation of energy a basis resting on experience.

ARNOLD BERLINER.

Professor The Right Honourable Lord Rutherford of Nelson, O.M., D.Sc., LL.D., Ph.D., F.R.S.

THE news of the sad demise of Lord Rutherford, Cavindish Professor of Experimental Physics and Director, Cavendish Laboratory, since 1919, President elect of the Jubilee Session of the Indian Science Congress, Calcutta, 1938, reached us as we were going to the press. It is with feelings of deep sorrow that we record the obituary of this eminent investigator whose contributions to the scientific thought during the past four decades have been both varied and remarkable, and formed an outstanding feature of the present era. Ernest Rutherford, first Baron of Nelson, KT., O.M., F.R.S., Nobel Prizeman, was born at Nelson, New Zealand, on 30th August 1871. He was educated at Nelson College, and Canterbury College of the New Zealand University. He then proceeded to the United Kingdom for higher studies and passed the M.A. Degree Examination of the Cambridge University with 1st class honours in Mathematics and Physics in 1893. His record has been all through, one of untarnished brilliance. He was awarded the 1851 Exhibition Scholarship in 1894. He entered the King's College and prosecuted research at the Cavendish Laboratory. His brilliant researches have brought him "crowded" recognition. Several Universities of Europe and America vied with each other in conferring on him their highest academic distinctions. He was awarded the Rumford Medal (1905), Copley Medal (1924), Albert Medal (1928), Faraday Medal (1930), and he received the Bressa Prize from the Turin Academy of Sciences in 1908. He was President of the Royal Society 1925–30; President, British Association for the Advancement of Science, 1923, Macdonald Professor of Physics, McGill University, Montreal, 1898–1907, Langworthy Professor and Director, Physical Laboratory, University of Manchester, 1907–19 and Fellow of the Trinity College since 1919. He is the author of numerous technical contributions on the Conduction of Electricity through Gases and Radioactivity which adorn the pages of the *Transactions of the Royal Society*, *Philosophical Magazine* and other scientific Journals. Among his other publications mention should be made of: Radioactivity (1904), Radioactive Transformations (1906), Radioactive substances and their Radiations (1912) and Radiations from Radioactive substances (1930).

E Rutherford

Rates of Growth of Non-Vegetarian and Vegetarian Children of Trivandrum, Travancore.

By Eileen W. Erlanson Macfarlane.

(Collaborator in Asiatic Research, University of Michigan, U.S.A.)

HEIGHTS and weights of over 700 children between the ages of 3 and 17, were taken at Trivandrum, Travancore, in 1934. Since then heights and weights of children in the Madras Presidency, in Calcutta and the Punjab have been published by Aykroyd, Wilson and others in connection with nutritional research. Because it is desirable to have data from as many communities as possible these figures for Trivandrum are presented.

The majority of these measurements were made in connection with an anthropological study of the Mukkuvar fisherfolk, and these children make up most of the "mixed diet" group in Tables I and II. The Mukkuvars are a poor fishing community who are probably of Tamil origin. Almost all of them are Christians and measurements were made in the Roman Catholic Sunday School and Vernacular School, Vettukadu, through the co-operation of the Rev. Father G. A. Godinho. Although both boys and girls were measured, most samples of children above 13 years old are too small to record. Measurements are given for 695 children.

The diet of the Mukkuvars consists chiefly of rice *plus* lime pickle (citrus fruit and chilli in brine), jaggery (palm

TABLE I.

Average height and weight for age of mixed diet and vegetarian school-boys of Trivandrum and of poor Bengali Hindus.

Age	Trivandrum						Calcutta		
	Mixed Diet			Vegetarian			Poor Bengali Hindus		
	Number of boys	Height in inches	Weight in pounds	Number of boys	Height in inches	Weight in pounds	Number of boys	Height in inches	Weight in pounds
3	11	37·9	27·8	..	..	..	..	..	..
4	15	41·6	33·1	..	..	..	..	..	..
5	18	42·2	35·2	..	..	..	..	..	..
6	14	43·4	36·9	17	44·6	38·8	..	..	..
7	15	46·3	43·2	25	45·6	40·1	114	45·43	39·19
8	20	46·9	43·4	25	46·6	43·0	140	47·55	43·45
9	34	49·4	49·1	27	49·4	47·8	104	48·85	46·34
10	15	49·6	49·6	15	49·6	49·6	121	50·63	50·20
11	24	52·7	57·5	20	52·5	55·1	87	53·15	56·23
12	17	53·2	58·8	20	53·6	59·0	32	55·75	64·30
13	10	56·4	68·3	12	56·7	70·0	..	..	..
14	..	..	..	25	58·7	77·0	..	..	..
15	12	60·5	89·3	..	..	..	..	..	..

TABLE II.

Average height and weight for age of mixed diet and vegetarian school-girls of Trivandrum.

Age	Mixed Diet			Vegetarian		
	Number of girls	Height in inches	Weight in pounds	Number of girls	Height in inches	Weight in pounds
3	12	36·5	27·3	..	..	..
4	18	39·9	31·5	..	..	..
5	14	42·7	36·2	..	..	..
6	17	42·9	34·7	16	42·9	35·1
7	17	45·2	39·6	10	46·0	42·6
8	20	46·3	42·9	13	47·0	43·6
9	33	48·1	45·8	25	49·2	47·2
10	24	48·9	49·0	20	50·6	51·7
11	16	52·4	55·4	14	52·9	61·4
12	13	54·9	65·6	..	..	..
13	12	59·3	83·8	..	..	..

sugar) and small amounts of fish and coconut oil. Fresh vegetables and fruit are eaten only occasionally. These people live on the sandy beach among privately owned coconut palms. In spite of the fact that they handle large quantities of fish they try to market all of it, either fresh, or dried, or as manure and seldom eat it themselves. They occasionally eat large prawns (shrimps) and small crabs, but their diet is undoubtedly poor in proteins, vitamins and mineral salts. Milk is beyond their means and the only "milk" that children get after they are weaned is some coconut water. They sometimes eat small quantities of dahl (pulse), ragi (millet), sweet potatoes, onions, plantains (fried or raw), fresh tapioca, also mangoes and Jack fruit (*Artocarpus integrifolia*). Some coriander seeds, turmeric and capsicum are used as condiments. No detailed survey was made of the actual quantities of food consumed daily; the people were questioned and some meals inspected. Their diet closely resembles that of the poor families near Chingleput, Madras, analysed as Group I by Aykroyd and Krishnan (1937) and is "composed almost exclusively of home-pounded parboiled rice". *Conjee* or strained rice gruel is taken in the morning and the main meal of rice and perhaps a little fish is consumed at noon. In the evening more rice is eaten, or some little cakes made of rice flour, jaggery and water. Their only beverage is water, and now and then some toddy. They own no live-stock or poultry as there is no pasture under the coconut groves or along the shore where they live.

Among the "mixed diet" children, there are also included a few low caste Hindus from the schools in the Trivandrum Fort and Chalai District schools who eat fish, chicken and eggs when these are obtainable.

The vegetarians are Brahmin and Nair children who were measured at the Government Schools in the Fort, also at the Christian Mission Zenana School and the Mahila Mandiram (Hindu) Orphanage. These children belong to better class families than the non-vegetarians. Although rice is still the staple food the vegetarians get larger amounts of vegetable proteins, more coconut oil, vegetables and fruit, than the poor mixed diet children. The vegetarians all consume some ghee (rendered butter) also curds and butter milk or whole milk. It was expected that they would exceed the others in weight at all ages.

The children were weighed without shoes wearing one layer of cotton clothing (*vide* Aykroyd, 1936) the average weight of which was one pound or less. Nothing has been subtracted for weight of clothes as this has not been done by most other authors. A Belmont portable spring balance was used. This is adjustable and was calibrated with standard weights periodically. Weights were taken to the nearest pound. Height was measured on a rigid steel rod in millimetres and the values have been converted to inches because all data for Indian children have been published in English weights and measures, except those for Goa (Correia, de Figueiredo).

The data for the Trivandrum boys are given in Table I together with similar data for poor Bengali Hindus at Calcutta (Wilson *et al.*). The heights and weights

of Trivandrum boys are expressed graphically in Figs. 1 and 2 together with the curves for Calicut boys from Aykroyd (1936). The data for girls is given in Table II and there are no others published yet for comparison.

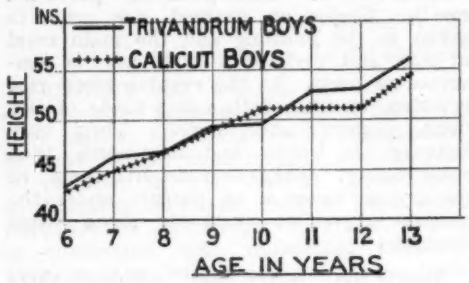


Fig. 1.

Height-age graphs of non-vegetarian boys of Trivandrum and Calicut.

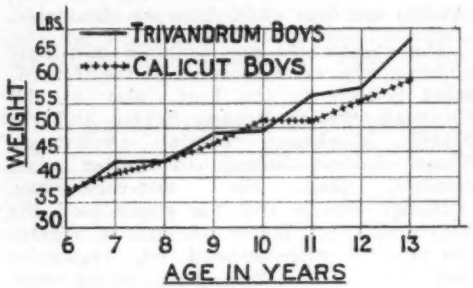


Fig. 2.

Weight-age graphs of non-vegetarian boys of Trivandrum and Calicut.

Up to the age of 10 years, the data for non-vegetarians and vegetarians of Trivandrum, for poor Bengali Hindus and Calicut boys, resemble each other closely. After 10 years the Bengali boys begin to outstrip the Malayalis somewhat in height and weight, the vegetarians of Trivandrum become heavier than non-vegetarians of equivalent ages and the Calicut boys lag behind in both height and weight. Whether race or diet is responsible for this is at present not known.

The mean annual increments in stature for Trivandrum boys and girls between 6 and 13 years, are given in Table III together with those for children in other parts of India. The Trivandrum and Calcutta children show a spurt in growth between 10 and 11 years. The maximum annual increment for all communities is between 12 and 13 years. Correia (1931) also found that the greatest average annual gain in height occurred between 12 and 13 years among the domiciled Portuguese children of Goa. The Bengali poor Hindus show a more regular gain in stature each year than any of the South Indian communities. Some of the latter, particularly Calicut and Mayanur boys, show very poor

TABLE III.

Mean annual increments in stature of various Indian children.

Age period	Trivandurm				Coonoor Males	Calicut Males	Mettupalayam Males	Mayanur Males	Calcutta Poor Bengali Hindu Males
	Males		Females						
	Mixed diet	Vegetarian	Mixed diet	Vegetarian					
6—7	2·98	0·94	2·36	3·17	2·5	2·8	1·0	2·1	..
7—8	0·58	1·04	1·02	0·94	1·5	1·7	2·0	2·0	2·12
8—9	2·47	2·84	1·89	2·25	1·5	2·4	0	2·2	1·3
9–10	0·2	0·19	0·75	1·36	2·1	1·9	3·0	0·7	1·78
10–11	3·13	2·87	3·49	2·27	1·8	0	1·0	0·5	2·52
11–12	0·55	1·1	2·51	..	1·0	0·1	2·0	1·5	2·6
12–13	3·03	3·05	4·43	..	3·4	3·5	3·0	4·4	..

annual increments between the ages of 10 and 12.

TABLE IV.

Some average male heights and weights at the mean age of 13 *years.*

Community and investigator	Height in inches	Weight in pounds
Malayali—		
Trivandrum (Macfarlane)	56·6	69·5
Calicut (Aykroyd)	54·6	60·0
Tamil—		
Mayanur (Aykroyd)	55·9	68·5
Goanese—		
Marattas (de Figueiredo)	56·3	72·9
Whites (*ibid*)	56·7	75·6
Portuguese (de Correia)	55·9	80·5
English (Karn)	57·2	82·25

In Table IV, the average height and weight for all the Trivandrum boys of 13 years, non-vegetarian and vegetarian together, are compared with the heights and weights of some other Indian and European boys of the same age. The stature of the 13-year old Trivandrum boys is only 0·8 inches less than the average for south London school boys found by Karn (1936), but their weight is 11·5 pounds less. Both non-vegetarian and vegetarian girls of Trivandrum begin to put on weight more rapidly than the boys of similar age after reaching 10 years. The small sample of non-vegetarian Malayali girls of 13 years shows an average height of one inch more than London school girls of similar age (Karn) and they only lag behind the British girls in weight by 1·86 pounds.

Most of my samples are too small for statistical treatment. They have been given because the average height and weight values for each age class resemble so closely those for other Indian communities. In Table V all the children, mixed eaters and vegetarians for the ages 8 and 9 years, have been treated together and the statistical values are given.

TABLE V.

Mean heights in inches and weights in pounds of Trivandrum children at 8 *and* 9 *years.*

Sex and Age	Character	Total No.	Mean with P. E.	Standard Deviation with P. E.
Males, 8 yrs.	Height ins.	45	$46·84 \pm 0·21$	$2·07 \pm 0·14$
,, ,, ...	Weight lbs.	45	$43·51 \pm 0·50$	$4·95 \pm 0·35$
Males, 9 yrs.	Height ins.	61	$49·44 \pm 0·21$	$2·09 \pm 0·15$
,, ,, ...	Weight lbs.	61	$48·95 \pm 0·40$	$4·41 \pm 0·26$
Females, 8 yrs.	Height ins.	33	$46·40 \pm 0·21$	$1·69 \pm 0·14$
,, ,, ...	Weight lbs.	33	$43·28 \pm 0·58$	$4·83 \pm 0·39$
Females, 9 yrs.	Height ins.	58	$48·65 \pm 0·21$	$2·36 \pm 0·14$
,, ,, ...	Weight lbs.	58	$46·86 \pm 0·57$	$6·36 \pm 0·38$

Aykroyd, W. R., and Rajagopal, K., *Ind. Jour. Med. Res.*, 1936, **24**, 419–37.
Aykroyd, W. R., and Krishnan, B. G., *ibid.*, 1937, **24**, 667–88.
de Figueiredo, J. M. P., *Curr. Sci.*, 1936, **4**, 748–53.
Correia, A. C. G. de S., "Les enfants et les adolescents luso-descendants de l'Iede Portugaise," 1931.
Karn, M. N., *Journ. Eugen.*, 1936, **7**, 107–20.

LETTERS TO THE EDITOR.

PAGE

Hyperfine Structure in Germanium. By L. Sibaiya 152

A Possible Origin of the Shift of Spectral Lines in Nebulæ. By L. Sibaiya 152

Dielectric Polarisation and Form of the Carbon Dioxide Molecule. By K. L. Ramaswamy .. 153

Light Absorption of Potassium Permanganate. By A. L. Sundara Rao 154

Study of Oxy-Coal-Gas Flame by Band Spectra. By N. R. Tawde and J. M. Patel 155

PAGE

Rottlerin. By K. S. Narang, J. N. Ray and B. S. Roy 156

A New Colour Test for Chromates and Dichromates. By B. K. Nandi 156

Current Bedded Pebbles in the Dharwar Conglomerates. By B. Rama Rao 157

Sorghum halepense *and* Sorghum sudanense—*A New Difference.* By G. N. Rangaswami Ayyangar and B. W. X. Ponnaiya . 158

The Kashmir and Rajputana Lac Insect. By S. Mahdihassan 159

Hyperfine Structure in Germanium.

The isotopic constitution of germanium, according to Aston, is as follows :—

Mass Number	70	72	73	74	76
Relative Abundance	21·2	27·3	7·9	37·1	6·5

A study of the hyperfine structure of some significant arc lines of germanium was undertaken to investigate the presence, if any, of the even isotopic displacements in the gross multiplet levels; and it was also hoped to determine the nuclear spin of the odd isotope Ge^{73}. Using a hollow cathode discharge, the following arc lines of germanium were examined for hyperfine structure :—

λ in I.Å.	Classification*
3039·07	$4p^2\ {}^1D_2 - 4p5s\ {}^1P_1$
2754·59	$4p^2\ {}^3P_2' - 4p5s\ {}^3P_1$
2709·63	$4p^2\ {}^3P_1' - 4p5s\ {}^3P_0$
2691·35	$4p^2\ {}^3P_1' - 4p5s\ {}^3P_1$
2651·57	$4p^2\ {}^3P_0' - 4p5s\ {}^3P_1$
2651·19	$4p^2\ {}^3P_2' - 4p5s\ {}^3P_2$
2592·54	$4p^2\ {}^3P_1' - 4p5s\ {}^3P_2$

All the arc lines listed above were found to be single. The known relative abundance of the even isotopes of germanium renders it certain that none of the levels here examined shows any isotope displacement. The absence of hyperfine components arising from the nuclear spin moment of the odd isotope Ge^{73} leads to the conclusion that the magnetic moment of the nucleus is very small. The possibility of the appearance of the faint hyperfine components due to Ge^{73} on longer exposures (*i.e.*, longer than two hours which I have tried) is very little, though it is not definitely ruled out.

I wish to thank Prof. A. Venkata Rao Telang for his helpful guidance.

L. Sibaiya.

Central College,
University of Mysore,
Bangalore,
October 5, 1937.

* Gartlein, *Phys. Rev.*, 1928, **31**, 782–92.

A Possible Origin of the Shift of Spectral Lines in Nebulae.

Spectroscopic examination of the extra-galactic nebulæ by Slipher and Humason has revealed the fact that the absorption lines, especially the H and K lines, are displaced towards the red in most cases. Assuming this effect as arising from a Doppler shift, Hubble has concluded that the speeds of recession of the nebulæ are proportional to their distances; the claim that this conclusion is accurate to 20% is not conceded by many astronomers. There are, besides, a few galaxies which, on the

Doppler hypothesis, should be interpreted as moving towards us. Zwicky's theory, that the photon parts with some of its energy to the cosmic matter thinly strewn in the intergalactic space through which it passes, is now considered untenable.

The shift of the principal series lines of the alkalis in their absorption spectra in the presence of foreign gases affords a new clue for the explanation of the spectral shift in nebulæ. Many investigators have shown that, at a few atmospheres pressure of gases such as hydrogen, helium, neon or argon, the absorption spectra of alkalis exhibit displaced lines.* This displacement takes place towards the violet in the cases of hydrogen, helium and neon; while a red shift occurs with argon and probably also with krypton and xenon. According to Fermi's theory, the spectral shift in wave-numbers is

$$\Delta\nu = -2{\cdot}8 \times 10^7 \ (D-1)n^{\frac{1}{3}} \pm 0{\cdot}33\,\sigma^{\frac{1}{3}}n,$$

where D is the dielectric constant of the perturbing gas, n the number of molecules per c.c. and σ the collision cross-section. The agreement in the values of the effective cross-sections of the various gases for electrons of very slow velocity irrespective of the absorbing vapour confirms that the shift is independent of the kind of absorbing alkali atoms and depends only on the nature of the perturbing foreign gas. The nebular spectra are 'torpedo-shaped' continuous patches, containing practically as their only recognisable feature the H and K lines in absorption. A significant fact which should be remembered in connection with these lines is that they arise from absorption by ionised atoms of calcium ($4\,^2S_{\frac{1}{2}} \rightarrow 4\,^2P_{\frac{1}{2},\frac{3}{2}}$) which are isoelectronic with normal potassium atoms. Considering the observed displacements of H and K lines in nebulæ along with the laboratory results of the pressure shift of lines, it is possible to estimate the type and pressure of the foreign gas containing the alkali-like CaII atoms in the 'reversing layer' of the nebulæ. From the experimental data it follows that the displacement increases with the increase in pressure of the foreign gas at first linearly (up to 10 atms.) and later more rapidly. N.G.C. 221 with a violet shift should possibly contain in the reversing layer one of the lighter gases—hydrogen, helium or neon—at a pressure of about 80 atms. On the other hand, M 101 in Ursa Major, N.G.C. 385, N.G.C. 4,884 and the nebulæ in Leo exhibit a red shift arising from a possible presence of argon (or even krypton or xenon) at pressures ranging from 10 to 400 atms. At these pressures the existence of ionised calcium indicates a very high temperature which from Saha's theory is of the order of 10^6 degrees. This temperature refers to the reversing layers which lie next to the cores that give rise to the continuous spectra. The surface temperature can, however, be expected to conform to the stellar class to which the nebula belongs. The red shift of lines observed in a majority of cases finds an explanation in the fact that in those cases the heavy gases have gravitated to the reversing layer next to the luminous core; the few nebulæ which display a violet shift contain either mainly or exclusively the lighter gases.

L. Sibaiya.

Central College,
University of Mysore,
Bangalore,
September 12, 1937.

* E. Amaldi and E. Segre, *Nature*, 1934, **133**, 141; *Nuovo Cimento*, 1934, **11**, 145; C. Fuchtbauer, P. Schulz and A. F. Brandt, *Zeits. f. Physik*, 1934, **90**, 403; Ny Tsi-Ze and Ch'en Shang-Yi, *Phys. Rev.*, 1937, **51**, 567.

Dielectric Polarisation and Form of the Carbon Dioxide Molecule.

Ibbs and Wakemann[1] from the results on thermal diffusion of mixtures of carbon dioxide and hydrogen and on the temperature variation of viscosity of carbon dioxide, have concluded that "the molecules of carbon dioxide are of two definite kinds depending upon the temperature", and that "the *soft* low temperature molecule corresponds to a straight model while the *harder* high temperature molecule corresponds to a bent model". They deduced from their curves the temperatures of transition as 140° and 145° C. from viscosity and thermal diffusion data respectively. If the molecule does undergo such a change into a bent structure, the new form should be polar and would have a higher electrical polarisation. One should observe also a change in the molar refraction, though of a very small magnitude. Goldschmidt and Holemann[2] have measured the refractivity of carbon dioxide over a large range of temperatures and find that the value is constant right up to 400° C.

It was considered of great interest to measure the electrical polarisation at different temperatures. With this object in view the dielectric coefficient of carbon dioxide at various temperatures ranging from 80° C. to 200° C. were measured accurately. The values of polarisation calculated from these measurements were identical within limits of experimental error and thus do not support the conclusions of Ibbs and Wakemann about a transition to a bent form.

Full details of measurements and discussion of results will be shortly published in the *Proceedings of the Indian Academy of Sciences.*

K. L. RAMASWAMY.

Department of Physics,
Indian Institute of Science,
Bangalore,
October 7, 1937.

[1] Ibbs and Wakemann, *Proc. Roy. Soc.*, (A), 1932. **134**, 613–43.
[2] H. Goldschmidt and P. Holemann, *Z. Physik. Chem.*, (B), 1936, **32**, 341–52.

Light Absorption of Potassium Permanganate.

THE selective absorption of potassium permanganate in water has been studied by several investigators notable among them being Formanek,[1] Merton,[2] Hagenbach and Percy,[3] Gombos[4] and more recently Vis and Simchen[5] and Lange and Schusterius.[6] Most of these authors confined their study to absorption in the visible region. The results obtained are not however completely concordant, there being no agreement either in the number of bands or in their positions. There is general agreement only as regards the positions of the two strong bands 5,260 Å and 5,460 Å. Merton and Hartley have recorded only three absorption bands, while Hagenbach and Percy observed six bands, but Gombos, Lange and Schusterius doubted the existence of one of these bands. Further the ultra-violet region is most lacking in data, the existing data on light absorption in this region being fragmentary.

In the course of an investigation on the photochemical effect of $KMnO_4$, the absorption spectrum of aqueous solutions of $KMnO_4$ has been investigated over the entire range from 9,000 Å to 2,000 Å. As source of light a 500 watt projector lamp was used for the visible region and a condensed spark between Zn-Cd and Sn-Pb electrodes for the ultra-violet. Various high dispersion spectrographs were used for different regions. By using solutions of concentrations ranging from 5×10^{-3}M to 5×10^{-4}M and quartz cells varying in thickness from 0·01 mm. to 10 mm. the absorption spectrum has been photographed so as to exhibit complete development of the band spectrum over the whole range.

The plates obtained were measured by the recording microphotometer thus determining the transmission percentages at different wavelengths which were uncertain in former work.

It is found that the absorption spectrum consists of three distinct regions, the first extending from red to 4,250 Å, the second from 3,900 Å to 2,750 Å and the third from 2,600 Å to 2,000 Å.

In the visible region besides confirming the six bands obtained by Hagenbach and Percy[3] and finding their absorption maxima accurately another new band with maximum at 5,920 Å was obtained. I could not find the band 6,350 Å which has been reported by Vis and Simchen. Possibly, it was only a contrast effect on their plates.

The second region consists mainly of two bands, one having its maximum at 3,535 Å and diffused almost symmetrically on both sides and another strong band with maximum at 3,130 Å. With very dilute solutions interesting phenomena are obtained in the ultra-violet region which cannot be studied in stronger solutions. This band showed a discrete structure consisting of about nine diffused bands. The following values were obtained for these:—

$\lambda\lambda$ 3,400; 3,325; 3,210; 3,194; 3,110; 3,055; 2,950; 2,855; 2,800 (?) With concentrated solutions another band developed at 3,925 Å which gradually merges with the bands at 3,535 Å and 3,130 Å till at last the whole region formed one continuous band.

The third or ultra-violet region consisted of two bands with their maxima at 2,380 Å and 2,050 Å. It is found that absorption increases with decrease of λ, the band on the short wave-length side becoming for 1/500 M, a completely continuous region extending from 2,580 Å to 2,000 Å. Further investigation of the band 3,535 Å is in progress.

The full paper containing a detailed description of the methods, the photochemical effect of different radiations and their significance will shortly appear elsewhere.

I wish to express my cordial thanks to the Director, Kodaikanal Observatory, for helping me in working with the microphotometer.

A. L. SUNDARA RAO.

Kodaikanal,
July 1937.

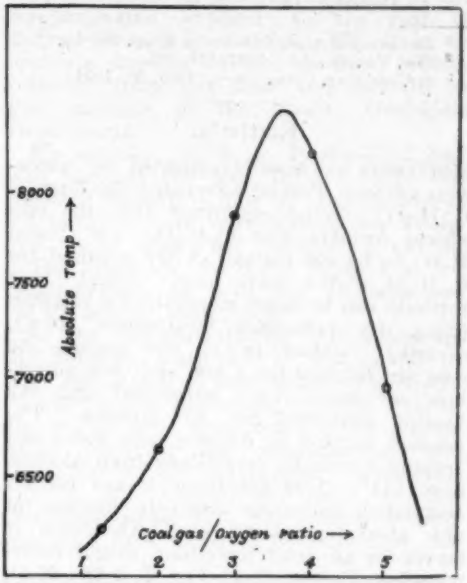
[1] *Spectralanalyse*, 1905, 2 Aufl, 134.
[2] *J. C. S.*, 1911, **99**, 637.
[3] *Helv. Chim. Acta.*, 1922, **5**, 462.
[4] *Bioch. Z.*, 1924, **151**, 1, 7.
[5] *Comptes Rendus*, Oct, 1931, **193**, 581.
[6] *Zeit. f. Phys. Chem.*, (A), 1932, **159**, 295.

Study of Oxy-Coal-Gas Flame by Band Spectra.

THE oxy-coal-gas flame is known to emit Swan system of C_2 bands with great purity and its intensity is governed by conditions of coal gas and oxygen supply. Thorpe[1] points out that on admission of oxygen, the colour as well as the size of the flame change and this change can be correlated to the temperature of the flame. It was thought desirable to study this aspect quantitatively by taking advantage of the C_2-Swan system and the quantum laws governing the distribution of energy among its various vibrational levels. Good deal of work done so far to assign temperature of thermal equilibrium to sources in the process of emission on the basis of known intensity laws, is still of non-confirmatory character and this lent us further support to undertake this kind of work.

The oxy-coal-gas flame has been produced by a blow-pipe burner specially prepared for this work. The nozzle through which the gas issued and was ignited in the atmosphere had a jet opening of 1·95 mm. diameter. The coal gas was taken at a constant pressure from the usual city supply and was allowed to leak by a side tube in the oxygen within the burner, such that it maintained different ratios with the coal gas pressure. The observations in these experiments were restricted to the gas/oxygen ratios of 1·25, 2, 3, 4 and 5. Intensity measurements of Swan bands in the flame under these conditions were made by applying the methods of photographic spectral photometry, the details of which have been sufficiently treated in a paper by Johnson and Tawde.[2]

From the observed values of intensities, temperatures have been calculated on the assumption that molecules are in thermal equilibrium in the various initial vibrational states. The relation between these and gas/oxygen ratios has been shown below. It gives maximum temperature



in the neighbourhood of ratio 3·5, a result which does not agree with the one expected from the size of the flame cone, though the nature of the graph on the whole is similar to one found by Loomis and Perrott[3] by other methods. For maximum temperature, the size of the flame cone should be minimum and this we have obtained near the ratio 2·3. One can explain this departure if the variation in temperature (which is of the order of 500°) from one ratio to another is such as not to cause an appreciable redistribution of gross intensities. On the other hand, the absolute values of temperatures which have been found to be very high (about 7,000° K.) in comparison to true temperatures (2,500° to 3,000° K.) of the flame, are an indication of the non-existence of thermal equilibrium of vibrational energy. Attempts are being made to interpret the intensity distribution of Swan bands as produced in the bunsen burner and kerosene-oil stove in terms of these results. Details of the work along

with other aspects are being published elsewhere in a separate paper.

N. R. TAWDE.
J. M. PATEL.

Royal Institute of Science,
Bombay,
August 5, 1937.

[1] *Dictionary of Applied Chemistry*, **3**, pp. 206–15.
[2] *Proc. Roy. Soc.*, (A), 1932, **137**, 575.
[3] *Ind. and Eng. Chem. Journ.*, 1928, **20**, 1004.

Rottlerin.

ROTTLERIN has been investigated by numerous authors. Perkin[1] advocated the formula $C_{33}H_{30}O_9$. Telle[2] confirmed that the empirical formula was $C_{11}H_{10}O_3$ but found M.W. to be 496 instead of 570 required for $C_{33}H_{30}O_9$. We have now found that rottlerin can be easily methylated if rottlerin (2 g.), dry potassium bicarbonate (16 g.), dimethyl sulphate (8 c.c.) and acetone (50 c.c.) are refluxed for 4 hrs. and then potassium carbonate (8 g.) introduced and the heating continued for 45 minutes. The product isolated by dilution with water and keeping overnight crystallises from alcohol, m.p. 144°. This substance is not further acetylated indicating complete absence of any alcoholic groups, etc. Therefore, it serves for an exact molecular weight determination. Found: C, 71·71; H, 6·65; MeO, 24·13; M.W. (micro Rast) 524; $C_{27}H_{22}O_3(OCH_3)_4$ requires C, 71·81; H, 6·56; MeO, 23·94; M.W. 518. These data cannot be explained on the basis of C_{33} formula for rottlerin. Again tetrahydro-rottlerin, formed by catalytic hydrogenation of rottlerin gives an acetyl derivative m.p. 178° which gave M.W. 630, 641, 642 respectively in benzene, agreeing with the C_{27} formula. It analysed as C, 65·92; H, 5·69; whilst the C_{33} formula would not accommodate these data. The tetramethyl ether of tetrahydro-rottlerin, m.p. 108°, prepared in the manner described above also gave M.W. and analytical values only agreeing with the C_{27} formula.

When rottlerin tetramethyl ether is oxidised by alkaline hydrogen peroxide, it is quantitatively converted into a substance $C_{31}H_{30}O_8$, m.p. 128° (decomp.). This substance on catalytic reduction is transformed into tetramethyl ether of tretahydro-rottlerin.

Rottlerin tetramethyl ether gave a substance $C_{19}H_{21}O_6N$(?) with sodium nitrite and acetic acid which can be catalytically reduced to $C_{19}H_{23}O_6N$. The substance $C_{19}H_{21}O_6N$ decomposes into benzaldehyde with alkali.

These various derivatives of rottlerin are being further studied.

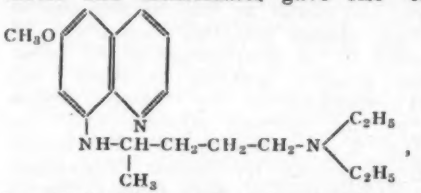
K. S. NARANG.
J. N. RAY.
B. S. ROY.

University Chemical Laboratory,
Lahore,
October 4, 1937.

[1] Perkin, *J.*, 1895, **67**, 230.
[2] Telle, *Arch. Pharm.*, 1906, **244**, 441.

A New Colour Test for Chromates and Dichromates.

WHILE investigating to find out a suitable colour test for the newly discovered antimalarial drug 6-methoxy-8-(α-methyl-δ-diethyl amino butyl) amino quinoline, (Plasmoquine), it was noticed that chromates and dichromates gave rise to a



beautiful rich purple colour with plasmoquine in presence of oxalic acid at a pH below 6·5. Although the colour fades quickly and disappears gradually giving finally a colourless solution, it gives an excellent qualitative test for all chromates and dichromates at a dilution upto 1 in 100,000. Whilst investigations are in progress to stabilise the colour for a basis of quantitative colourimetric determination of plasmoquine at high dilutions (1 in 500,000) in the animal tissues, blood and urine, it is worthwhile mentioning here that the colour is specific for chromates and dichromates and so far as can be roughly ascertained, the intensity of the colour seems to be directly proportional to the concentrations of plasmoquine and the chromates or the dichromates. Incidentally, however, the stabilisation of the colour will also give a very simple colourimetric method for analytical estimations of chromates and dichromates at high dilutions.

A spectrum of the colour shows a characteristic selective absorption in the visible. The colour is discharged very quickly on warming, but remains for a considerable

length of time in ice-cold water. The phenomenon is definitely that of an oxidation of plasmoquine, where probably a transient semi-quinone type compound is formed by partial oxidation. If the colour could be stabilised at the ordinary temperature it should be possible to subject it to a potentiometric study according to Michaelis,[1] and also investigate for paramagnetic properties according to Taylor and Lewis,[2] for any semiquinone type phenomena.

A striking coincidence is that the complex acids of tungsten and molybdenum which also belong to the same group as chromium (Group VI) in the Periodic Table of classification of elements, also develop a characteristic blue colour with plasmoquine in an alkaline medium. This latter investigation has been studied at length and is being communicated for publication.

B. K. NANDI.

Department of Pharmacology,
Haffkine Institute, Bombay,
September 28, 1937.

[1] Michaelis, L., and Hill, E. S., *Jour. Amer. Chem. Soc.*, **1933, 55**, 1481.
[2] Taylor, N. W., and Lewis, G. N., *Proc. Nat. Acad. Sci.*, **1925, 11**, 456.

Current Bedded Pebbles in the Dharwar Conglomerates.

IN April 1935, while studying the nature of some of the conglomerate beds in the neighbourhood of Saulanga and Bikonhalli (Shimoga District), I noticed in some of them a few pebbles of quartzite with indications of current bedding. The pebbles were small, hardly exceeding 2 or 3 inches in diameter and consequently their structure was not well pronounced. Subsequently in December 1936, while examining the eastern extension of these conglomerates in the neighbourhood of Holalur, I was able to find many more of such pebbles, the bigger ones being nearly 1½ to 2 feet in length. Some of them show the current bedded structure very well as could be seen from Fig. 1.

In February of this year when examining a portion of the Chitaldrug schist belt, I noticed again quite a large number of pebbles of quartzite with well-pronounced current bedded structure, occurring in the conglomerates exposed to the east of Talya (Holalkere Taluk). Fig. 2 is an accurate drawing of one of such pebbles collected from this area and retained in the musuem of the Mysore Geological Department.

My assistant Mr. B. N. Raghunatha Rao who mapped the area further south has collected recently a few of such pebbles in the conglomerates near Madadkere. Therefore, it is clear that pebbles of current bedded quartzites do occur in some of the conglomerates of both the Shimoga and the Chitaldrug schist belts.

In the Saulanga-Holalur occurrences of the Shimoga schist belt I was unable to trace the source of such pebbles, since the current bedded and ripple marked quartzites of the area were found to be consistently overlying the conglomerates and consequently of a younger formation. But in the vicinity of Talya in the Chitaldrug schist belt, the current bedded quartzites were found to be older than the

Fig. 1. Quartzite pebble showing current bedding.
From the conglomerate bed about 6 fur. N.W. of Holalur.

Fig. 2.
Current bedded quartzite pebble from Talya conglomerate.

conglomerates and underlying them. In this area it was clear that such pebbles were derived from the breaking down of the pre-existing older current bedded quartzites. It is probable that there are different series of current bedded quartzites in the Dharwars and those older than the conglomerates have evidently formed the source of the current bedded pebbles.

The classification and correlation of the quartzites, conglomerates and the other constituents of Dharwars will be dealt with fully in due course in the publications of the Mysore Geological Department. But for the present it would suffice to lay stress on the fact that the finding of the current bedded pebbles in the conglomerates forms one more proof in support of the sedimentary origin of some of the Dharwar conglomerates. There does not seem to be any other recorded instance from other parts of India, wherein such current bedded pebbles have been noticed in the Dharwar conglomerates.

B. RAMA RAO.
Mysore Geological Department,
Bangalore,
September 27, 1937.

Sorghum halepense and *Sorghum sudanense*—A New Difference.

Sorghum halepense (Linn.) Pers. (Johnson grass) is a perennial with rhizomes and with the chromosome number $2n = 40$. *Sorghum sudanense* Stapf. (Sudan grass) is an annual with the chromosome number $2n = 20$.[1] In Johnson grass the spikelets are small $4 \times 2 \times 1$ mm. and break through callus at suture.[2] Sudan grass has bigger spikelets 5 to 7×2 to $2{\cdot}5 \times 1{\cdot}25 \times 2$ mm. and breaks with bits of rachis attached. These characteristics have so far served to separate these two grasses allied to sorghum, the great millet.

The anthesis of cultivated sorghum at Coimbatore has been recorded[3] in great detail. It is found that the period of intensive anthesis is just past midnight and then the anthesis slows down and continues in a weak measure till the morning.

Observations on the anthesis of Johnson and Sudan grasses at Coimbatore show that the period of their anthesis is very short, less than an hour. Sudan grass finishes its flowering before sunrise, usually between 5-30 and 6 A.M. but Johnson grass flowers only after sunrise, between 8-30 and 9-30 A.M. This habit of flowering, well after sunrise has helped in spotting out mixtures of Johnson grass among Sudan grass.

It is interesting to note that the flowering period of Johnson grass (8-30 to 9-30 A.M.) is also the flowering period of the three wild sorghums, *viz.*, *S. versicolor*, J. N. Anderss, *S. purpureo-sericeum* Aschers. et Schweinf., and *S. dimidiatum* Stapf. all belonging to the section *Para-sorghum*[4] (chromosome number $2n = 10$).

The crisp period of anthesis and the day-flowering habit of Johnson grass and of the *Para-sorghums* stand out in contrast to the pre-day flowering of Sudan grass and the night flowering of the cultivated sorghums.

Sudan grass crosses readily with cultivated sorghums. Both have their chromosome number $2n = 20$. Both flower predominantly before sunrise. Sudan grass has thus affinities to cultivated sorghums in anthesis also. How far domestication in arid regions has brought about this preday flowering and how much further selection for compactness in the head has pushed the anthesis to very near midnight raises interesting problems which can be solved only after intensive observations on a wide range of sorghum material.

G. N. RANGASWAMI AYYANGAR.
B. W. X. PONNAIYA.

Agricultural Research Institute,
Coimbatiore,
September 24, 1937.

[1] *Jour. Agric. Res.*, 1932, **44**, 317-21.
[2] *California Agric. Dept. Farmers' Bull.*, 1917, **126**.
[3] *Indian Jour. Agric. Sci.*, 1931, **1**, 445-454.
[4] Snowden, *The Cultivated Races of Sorghum*, 1936.

The Kashmir and Rajputana Lac Insect.

E. J. PARRY'S Book on Shellac (Pitman, 1935), which came only recently into my hands, gives an excellent review of the work done at the Lac Research Institute, Ranchi, India, ignoring, unfortunately similar work done at the Indian Institute of Science, Bangalore, initiated by Prof. G. J. Fowler long before the foundation of the Ranchi Institute. Parry quotes and endorses a criticism of my views by Howlett, believing it impossible for the lac insect to feed on gums. This probability was long ago confirmed by a study of the symbiotic fungus from lac by Srinivasaya and myself[1] while a reply to Howlett's other criticisms has recently appeared in the *Zeit. f. ang. Entom.* (July 1936, **23**). The Report on Lac[2] which contains only scathing references to my work further ignores that it was I who had sent brood lac to Howlett confirming a statement that there is a distinct species of lac insect in Mysore with three life-cycles a year.[3]

I still maintain that there are some half-a-dozen lac insects in India one of which is *Lakshadia fici*, described by Green. I recognised the existence of this species[4] while Chamberlin's Monograph,[5] appearing shortly afterwards, independently acknowledged the same. The lac insect of Kashmir growing there on *Acacia catechu*, was first identified by me as *Lakshadia fici* and appears to be the only statement to this effect,[6] while the numerous publications from Pusa and from Ranchi, to which alone Parry has referred, do not inform him of the specific nature of the Kashmir lac insect.

No writer on lac has so far mentioned that it was Lt.-Col. Adams[7] who says for the first time "Some (larvæ) are brilliant red, while others were yellow". I identified the Rajputana insect also as *Lakshadia fici*, whereas, Negi, of the Ranchi Institute, who even illustrates this insect[8] completely ignores its specific identity.

The following questions now press for solution. Is the insect named *L. fici* so rare that no one has been able to come across it again, it being particularly remembered that lac insects may be had in pounds if not even in hundredweights? Is the insect in Kashmir and Rajputana identical with each other and is it only a variety of the other lac insect commonly found in India so that a specific designation as given by Green is not justifiable? On the contrary if *L. fici* represents a distinct species then there are other insects, *e.g.*, *Lakshadia mysorensis*, likewise distinct, which require similar scientific designations.

Finally, I may add that in the article on Nomenclature of Lac Insects,[9] I have explained how the generic name *Lakshadia* has claims of priority over *Laccifer*.

S. MAHDIHASSAN.

American Express Co.,
Berlin.

[1] *J. Ind. Inst. Sci.*, 1929, **12A**, Pt. 6.
[2] *Ind. Forest Rec.*, 1921, **8**, Pt. 1.
[3] *Curr. Sci.*, 1934, **3**, 60.
[4] *J. Sci. Assoc. Vizianagaram*, 1923, **1**.
[5] *Bull. Ent. Res.*, 1923, **14**.
[6] *J. Sci. Assoc. Vizianagaram*, 1923, **2**, 63.
[7] *The Western Rajputana States*, London, 1899, with a Chapter on Lac.
[8] *Bull. Ent. Res.*, 1929, **19**, Pt. 4, Pl. 16.
[9] *Curr. Sci.*, 1935, **3**, 365.

REVIEWS.

The Cycle of Weathering. By Prof. B. B. Polynov; translated from Russian by Dr. A. Muir. (Thomas Murby & Co., London), 1937. Pp. xii + 220. Price 10*s*. 6*d*.

Pedology, the scientific study of soils, the long neglected child of geology, has now grown into a vigorous independent science and there are signs that geology may re-adopt this thriving off-spring. The scientific study of soils has been considerably developed during the last two decades or so by Russian investigators; and their work in Russian territories, Siberia and Central Asia, particularly on morphological problems, classification and regional distribution of the soil-groups, has done much to stimulate soil research in Europe and America. The soil is humanly speaking, the most interesting and important part of the earth's outer crust, the living shell enveloping the "crust of weathering" in which fundamental changes are constantly taking place in an unending cycle.

In the present book *Cycle of Weathering*, written by an eminent Russian pedologist, Prof. B. B. Polynov, and translated into English by Dr. Muir of the Macaulay Institute for Soil Research, Aberdeen, the object is to give a complete account of the various cycles of physical and chemical changes taking place in the outer few feet of the zone of weathering, the sub-soil and soil layers. In this way cycles of the principal crust-building elements, oxygen, carbon, nitrogen, silicon, aluminium, iron, the alkalies, sulphur and phosphorus are described. The questions considered are: in what compounds do these elements enter the zone of weathering; what changes do these compounds undergo in this zone and in what state or form do they leave it? These cycles of weathering summarise the chief reactions whose interplay results in the formation of sub-soil and soil on the surface rocks. An important chapter describes the residual and mobile products of weathering, their distribution and accumulation in various forms, the influence of climatic conditions on these processes, etc.

The translation of this useful manual will make available for English-speaking readers the important researches of Russian soil scientists. The book also has value to the student of sedimentary petrology as treating of the complex processes whereby the principal primordial rocks of the crust pass into the condition of soil compounds.

D. N. W.

An Outline of Atomic Physics. By Members of the Physics Staff of the University of Pittsburgh. (Chapman & Hall, Ltd., London), Second Edition, 1937. Pp. viii + 414. Price 18*s*. 6*d*. net.

The book under review is the second edition of an already well-known work entitled *An Outline of Atomic Physics*. A notable addition is the chapter dealing with neutrons, positrons and nuclei. In this chapter a concise account is given of how the neutron and positron were discovered. Their properties are briefly described. A section is devoted for the description of the conditions that are necessary for the production of electron-positron pairs from γ-ray photons and the reverse process in which the electron-positron pair is annihilated giving rise to radiation. The various types of modern apparatus employed for the purpose of generating high speed charged particles are described at some length with the help of a number of diagrams and photographs. The appendices given at the end of the book consisting of units, important physical constants, etc., have been revised and considerably enlarged. Appendix V dealing with "Heisenberg's uncertainty principle" has been deleted from this edition and the subject-matter has been incorporated into the book itself in a suitable place.

The treatment of the subject as presented in the book leans more towards the descriptive. As the authors themselves acknowledge, they have attempted to strike a middle course between a purely mathematical treatment and a purely descriptive treatment. The book forms an excellent reading for students who have already undergone a general college course in physics. It cannot, however, be regarded as complete in itself as a text-book for an advanced student of modern physics as

the mathematical proofs have been omitted in a number of cases. The matter in the several chapters is up-to-date and the treatment very satisfactory. It will form a valuable addition to a physics library.

S. BHAGAVANTAM.

The Retardation of Chemical Reaction. By Professor K. C. Baily. (Edward Arnold & Co., London), 1937. Pp. 479. Price 26*s*. net.

The author states in the Preface: "No book dealing with retardations in general has appeared in any language. The absence of a comprehensive bibliography of the subject makes it imperative that the work should include as far as possible a list of original papers" as the literature is spread over a number of titles and headings. "The order of chapters has been decided by the types of reactions." The "term 'retarder' should denote a substance which only brings about a diminution in velocity" and not a complete cessation of reaction. Certain topics "which have been handled adequately elsewhere" have been excluded. These are: Retardation by intensive drying; the poisoning of an intentionally introduced solid catalyst; the retardation of enzyme action; the diminution in reaction velocity by salt effects. In spite of these restrictions the scope and usefulness of the book will be illustrated by the fact that it contains a bibliography of 1,630 original papers and an additional author index. An historical account of each reaction has been given and most of the important reactions have been dealt with in detail; on the theoretical side there is a chapter on chain reactions and in the subject index references to mechanism of retardation have been collected under the heading "Theories of Retardation".

The value of the book lies in the large amount of information it gives and the book will be appreciated by research workers in kinetics of reaction. The practical interest of the reactions have been well emphasised. It appears that the intention has been mainly to give information and a connected presentation. In consequence, a critical evaluation of observation and theories has somewhat suffered but the book will undoubtedly be found to be useful by those interested in the subject.

J. N. MUKHERJEE.

Reagent Chemicals and Standards. By Joseph Rosin. (Chapman & Hall, Ltd., London), 1937. Pp. 530. Price 30*s*.

Many analytical and research chemists have often felt the need of quick and reliable methods of estimating the purity of the reagents they employ. Formerly, Merck's "Prüfung" met the need partially. In modern times manufacturers themselves supply their reagents with analytical data. Still a chemist would not and should not be satisfied unless he himself tested his chemicals.

A joint publication of B. D. H. and Hopkins and Williams on "Analar Standards" has appeared this year. The book under review covers the same ground, but contains more than double the amount of matter dealing with about 470 laboratory products arranged alphabetically. Under each are given the formula, the Mol. Wt., the percentage content of each constituent, physical properties, the "Assay minimum" and the maximum impurities to be expected. The introductory chapter contains valuable explanatory notes, while the concluding pages give detailed methods of preparation of standard solutions of varying strength, and extensive tables of equivalents. The only thing missing, perhaps, is a table of logarithms!

The author is Chief Chemist and Chemical Director, Merck & Co., Inc., and has had over 25 years experience in the production of reagents of a high standard of purity. The book is a distinct advance on existing publications, and is one which no analytical or research laboratory should be without. The price does not make it easy for inclusion in personal libraries, but every laboratory worth the name should be able to afford it.

M. R. N.

Laboratory Manual of Organic Chemistry. By R. B. Dey and M. V. S. Raman. (M. A. Srinivasachari & Sons, Madras), 1937. Pp. x + 234; xiv + 158.

It is always a pleasure for a teacher to come across a really good book in his subject, and this practical text-book is one which will give great pleasure to teachers of organic chemistry. It is well written and comprehensive; emphasis is laid both on the preparative and analytic aspects of the subject and the directions are carefully given so that little or no supplementary

help from the demonstrator should be necessary.

The book is divided into 2 parts. Part I is intended for the elementary student, but there are many practical hints in it, which the advanced student and even the teacher will find of value. It begins with an outline of the simpler operations, there follows a valuable chapter on the manipulation of small quantities of substances. Two chapters are devoted to the reactions of common organic compounds; there is then a chapter on qualitative analysis, which is followed by a valuable discussion on the preparation of derivatives. Chapter 7 giving model analyses of simple organic substances, is a useful innovation and will save the time both of the student and the teacher. Part I closes with details of 46 carefully chosen preparations designed to illustrate the fundamental operations of practical organic chemistry.

Part II opens with a chapter on the quantitative estimations most usually met with in organic chemistry, details being given for the more important groups. Chapter II deals with the separation and identification of typical mixtures, examples being given for the analyses of some simple mixtures containing 2 substances. There follows a very valuable chapter giving details of 35 advanced organic preparations which will be most useful not only to the undergraduate but also to the research student. Some most interesting syntheses are included. Finally, details are given for the macro and semi-micro determination of elements. The best modern practice is included and the book is up-to-date in every respect.

The authors are to be congratulated on producing a first rate book which can strongly be recommended. The illustrations are good and the binding and printing are satisfactory. There will be no necessity in the future to go outside India for a text-book of practical organic chemistry.

T. S. W.

Television Up-to-Date. By R. W. Hutchinson. (University Tutorial Press, Ltd., London), Second Edition, revised and enlarged, 1937. Pp. 212. Price 2*s.* 6*d.*

The book is a very useful contribution to students of television. It gives a clear account of the scientific and practical aspects of television. The different systems of scanning such as disc and mirror drum scanning, the talking film and intermediate film method, the electron image method and the electron beam or cathode-ray scanning are all described with full diagrams and explanations. The corresponding systems of reception are also well described, attention being paid to methods of synchronisation. The essential principles underlying the technique of television broadcasting and reception are well brought out in the book. Two chapters are devoted to a treatment of elementary principles and facts helpful to a novice. The illustrations, diagrams and general get-up of the book are very good.

A. VENKAT RAO TELANG.

Quelques Idées Actuelles sur la Structure des Metaux et des Alliages. By S. Goldstaub. (*Actualités Scientifiques et Industrielles.*) (Hermann et Cie, Paris.) Price 12 *fr.*

During the last fifteen years much work has been done on the crystal structure of metals and alloys. The development of this branch of physics has taken place at a time when there have been revolutionary changes in the modern physical theory of electrons and atomic structure. The application of these theories have led towards clarifying the fundamental principles underlying the structures of metals and alloys. The present position of our knowledge in this branch of physics and metallurgy is summarised in the monograph under review. The monograph is divided into three chapters, the first of which contains a review of the principal types of crystal structure exhibited by metals. The second chapter deals with the periodic classification of elements and its relation to their crystal structure while the third is devoted to the structure of alloys. The monograph provides an excellent summary in easy French, of the present state of our knowledge of metals and alloys and will be useful particularly to those who have not the time to study bulkier volumes on the subject which have appeared earlier.

S. R. S.

ANNUAL TABLES

OF CONSTANTS AND NUMERICAL DATA

Published under the auspices of the International Council of Scientific Unions and of the International Union of Chemistry

---

Address :

TABLES ANNUELLES
Institut de Chimie
11, rue Pierre Curie
PARIS (5°)

NEW SERIES: Numerical data of the years 1931-36, published in separate advance reprints by subjects. The publication of all sections will be finished towards the end of 1937.

TEXTS IN ENGLISH AND FRENCH

Just Appeared :

I. JOLIOT-CURIE, B. GRINBERG AND R. J. WALEN: **Radioactivity, Nuclear Physics, Transmutations, Neutrons, Positrons** (1931, April—1936) .. *Price* £ 0-8-0.

E. DARMOIS: **Rotatory Power** (1931–34) .. .. „ £ 0-8-0.

M. MAGAT: **Raman Effect, Vibration Patterns** (1931–34) .. „ £ 0-12-0.

Back Volumes and Sets: New prices considerably reduced:

Volumes (in 2 parts): IV (1913–16), V (1917–22), VI (1923–24), VII (1925–26), VIII (1927–28), X (1930), each volume .. *Price* £ 3-0-0.

Volume IX (1929) (in one part) .. .. „ £ 2-8-0.

Index Volume I–V (1910–22) .. .. „ £ 2-8-0.

Index Volume VI–X (1923–30) to appear towards the end of 1936.

Volumes I–III (1910–1911—1912) £ 11 can only be sold with the complete set I–X, because of limited stocks.

Reprints from back volumes: Information and prices will be supplied by the Editor's office. The purchase of reprints from Vol. X, IX and VIII will entitle to free supply of the corresponding reprints from back volumes, as long as copies are available.

Orders and Enquiries at the above Address.